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लोह ऑक्साइड ( पिंडक अयस्क,  
सिंटर तथा पेलेट ) के लिए टम्बलर  
परीक्षण की विधि  
( दूसरा पुनरीक्षण )

Method of Tumbler Test for Iron  
Oxides : Lump Ores, Sinter and  
Pellets  
( Second Revision )

ICS 73.060.10

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## FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Ores and Raw Materials Sectional Committee had been approved by the Metallurgical Engineering Division Council.

This standard was first published in 1972 and then subsequently revised in 1984. With the experience gained during these years the Committee felt the need to revise this standard. While revising this standard international practices have been duly considered.

In this revision the following modifications have been made:

- a) Number of test portions has been increased;
- b) Sub-clause 'Tumbler rotating drum' has been modified; and
- c) Sub-clause 'Sieves' has been modified by introducing 16 mm mesh aperture of sieves.

Tumbler test provides a measure of the resistance of iron oxides: lump ores, sinter and pellets to breakage or degradation by impact and abrasion.

In the formulation of this standard assistance had been derived from ISO 3271-2007 'Iron ores — Determination of tumbler strength', prepared by the International Organization for Standardization (ISO).

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2:1960 Rules for rounding off numerical values (*revised*).

## *Indian Standard*

# METHOD OF TUMBLER TEST FOR IRON OXIDES : LUMP ORES, SINTER AND PELLETS

*( Second Revision )*

### 1 SCOPE

This standard prescribes the method of tumbler test for the determination of resistance of iron oxides: lump ore, sinter and pellets to degradation by impact and abrasion.

### 2 REFERENCES

The following standards contain provisions which through in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

<i>IS No.</i>	<i>Title</i>
1405 : 2010	Iron ores — Sampling and sample preparation — Manual method ( <i>third revision</i> )
9101 : 1979	Method of sampling iron ore pellets

### 3 PRINCIPLE OF TEST

The test consists of placing the test sample in a standard tumbler drum and tumbled for a total 200 revolutions at 25 rev/min. The product is removed and sieved with test sieve having square opening of 6.3 mm and 500  $\mu$ m. The individual size fractions are weighed. From the masses of different size fractions obtained after sieving the tumbler and abrasion indices are calculated.

### 4 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply.

**4.1 Tumbler Index (T)** — The tumbler index is a relative measure of the resistance of the materials to breakage or degradation by impact.

**4.2 Abrasion Index (A)** — The abrasion index is a relative measure of the degradation of the material by abrasion.

### 5 TEST SAMPLE

#### 5.1 Gross Sample

The gross sample taken for the determination of tumbler

strength of a lot or part of lot shall be in accordance with IS 1405 or IS 9101.

#### 5.2 Preparation of Sample

The reduced sample shall be taken from the gross sample and oven dried at  $105 \pm 5^\circ\text{C}$ . The sample shall be allowed to cool to room temperature before performing the test.

##### 5.2.1 Iron Ore Lump and Sinter

The reduced sample shall be sufficient to obtain at least 100 kg of sinter or sized iron ore that will pass a 40 mm sieve and be retained on a 10 mm sieve. The test portion shall be separated in four fractions by sieving through 25.0 mm, 16.0 mm and 10.0 mm sieves. From the materials on three sieves, at least 2 test portions, each of  $15 \pm 0.15$  kg mass shall be prepared by taking proportionate mass of material from each sieve. The mass of the different fractions shall be recorded.

##### 5.2.2 Pellets

The reduced sample shall be sufficient to obtain at least 100 kg of pellets that shall pass 20 mm sieve and be retained on 6.3 mm sieve. The sample so obtained shall be separated into fractions by screening successively through 16 mm, 10 mm and 6.3 mm sieves. At least 2 test portions, each of  $15 \pm 0.15$  kg mass shall be prepared by taking proportionate mass of material from each sieve. The mass of the different fractions shall be recorded.

### 6 TEST APPARATUS

#### 6.1 Tumbler Rotating Drum (see Fig. 1)

It shall consist of a circle drum of 1 000 mm inside diameter and 500 mm inside length and shall be constructed of steel plate at least 5 mm in thickness. The drum shall be replaced whenever the thickness of the plate is reduced by wear to 3 mm in any area. Two equally spaced steel angle lifters 50 mm  $\times$  50 mm  $\times$  5 mm shall be solidly attached longitudinally over the entire length of the inner side of the drum by welding in such a manner as to prevent accumulation of materials between the lifter and the drum. The other lifter shall be positioned  $180^\circ$  from the first. The lifters should be fastened so that the attached legs point towards the

axis of the drum and away from the direction of rotation, thus giving a clear unobstructed shelf for lifting the sample. The lifters shall be replaced when the wear is such that the shelf measures less than 47 mm. The door should be so constructed as to fit into the drum to form a smooth continuous inner surface with the shell of the drum without having any gap between them and during the test shall be rigidly fastened to prevent loss of the sample. The drum should be rotated on stub axles attached to the ends of the drum by means of flanges, welded so as to provide smooth inner surfaces. The apparatus shall be fitted with a revolution counter and with an automatic device to stop the drum after predetermined number of revolutions. The apparatus shall be powered with a minimum of 1.5 kW so as to ensure the drum attains full uniform speed in one revolution, rotates uniformly, and stops within one revolution. The height of the drum axis shall not be more than 700 mm from the floor or the receiving container, to avoid any appreciable degradation of the sample while taking out the sample after the test due to excessive height of drop.

### 6.2 Sieves

Square mesh sieves or plates having the following designations shall be used:

40 mm, 25 mm, 16 mm, 10 mm, 6.3 mm and 500  $\mu$ m.

### 6.3 Scales

Three scales, one commercial type having a capacity of 100 kg, another having a capacity of 20 kg and the third having a capacity of 1 kg, each with a sensitivity of 1/1 000 or better, shall be used for weighing.

### 6.4 Riffle

For pellets having particle size up to 30 mm, riffle divider having an opening of 60 mm shall be used.

## 7 TEST PROCEDURE

The test sample shall be placed into the tumbler drum and the door fitted tightly. The drum shall then be rotated at  $25 \pm 1$  rpm for a total of 200 revolutions. All the materials shall be gently removed from the drum by slowly opening the door and sieved on 6.3 mm and 500  $\mu$ m sieves and the mass of the fractions retained on 6.3 mm sieve and that retained on and passing through 500  $\mu$ m sieve shall be determined.

## 8 RECORD

The sieve analysis after the test shall be reported to the nearest 0.1 percent, as the percent retained on the 6.3 mm sieve and the percent passing through 500  $\mu$ m sieve.

NOTE — The report of results shall mention the sampling point of the sample tested. Since degradation and degree of stabilization definitely depends on the construction characteristics of the installations, the results obtained by two different works are not necessarily comparable.

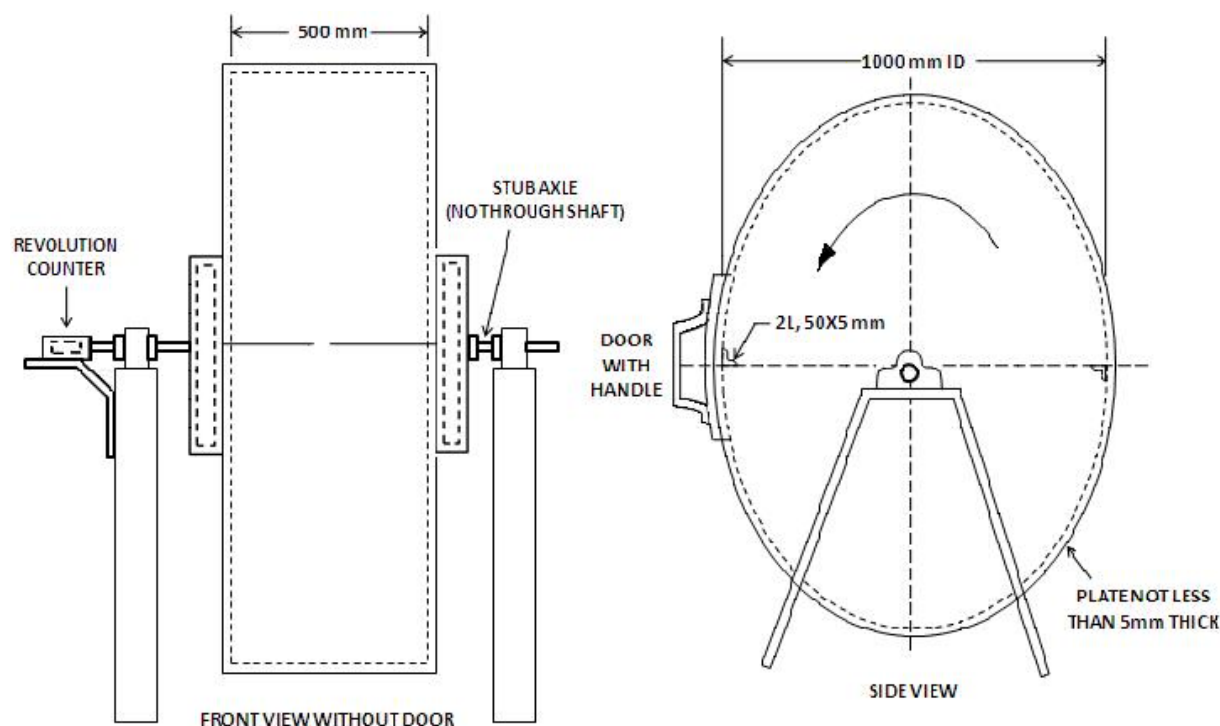


FIG. 1 TUMBLER TEST APPARATUS

## 9 CALCULATIONS

The tumbler index ( $T$ ) and the abrasion index ( $A$ ) shall be calculated to the first decimal by rounding off the second decimal in accordance with the following formula:

$$T = \frac{m_1 \times 100}{m}$$

$$A = \frac{m - (m_1 + m_2)}{m} \times 100$$

where

- $m$  = mass of the sample before test,  
 $m_1$  = mass of the sample retained on 6.3 mm sieve after the test, and  
 $m_2$  = mass of the sample passing through 6.3 mm and retained on 500  $\mu\text{m}$  sieves after the test.

## 10 NUMBER OF TESTS AND PERMISSIBLE TOLERANCES

### 10.1 Number of Tests

**10.1.1** A duplicate test shall be made on each sample of iron ore lump, sinter and pellets. If the difference between the paired values falls within the permissible tolerances given in **10.2** the mean value shall be reported.

**10.1.2** If the differences between the first paired values exceed the permissible tolerances, another duplicate test shall be made. If neither duplicate test conforms to the permissible tolerances, all values shall be individually reported and the four values shall be averaged.

### 10.2 Permissible Tolerance

The difference between the two values of the duplicate test shall fall within the permissible tolerance given in Table 1.

**Table 1 Permissible Tolerance in Absolute Percent**  
(Clause 10.2)

Sl No.	Tumbler Strength	Tolerance in Percent, Absolute
(1)	(2)	(3)
i)	Tumbler index ( $T$ ), percent (+6.3 mm)	1.4
ii)	Abrasion index ( $A$ ), percent (–500 $\mu\text{m}$ )	0.8

### 10.3 Permissible Mass Loss

The difference between the initial mass of the sample and the total of the fraction masses shall not exceed 1.0 percent of the initial sample mass. If this difference exceeds 1.0 percent, the test shall be rejected.

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### Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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